

STS-109
FLIGHT READINESS REVIEW

February 14, 2002

Ground Operations

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| AGENDA | |
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- Shuttle Processing
 - Integrated Operations J. Vevera
 - Shuttle Engineering G. Crews
 - Launch and Landing M. Leinbach
 - Summary D. King
A. Allen
C. Murphy

PROCESSING DIFFERENCES

Presenter:

Jim Vevera

Organization/Date:

Ground Ops/02-14-02

Processing Differences - VAB / Pad

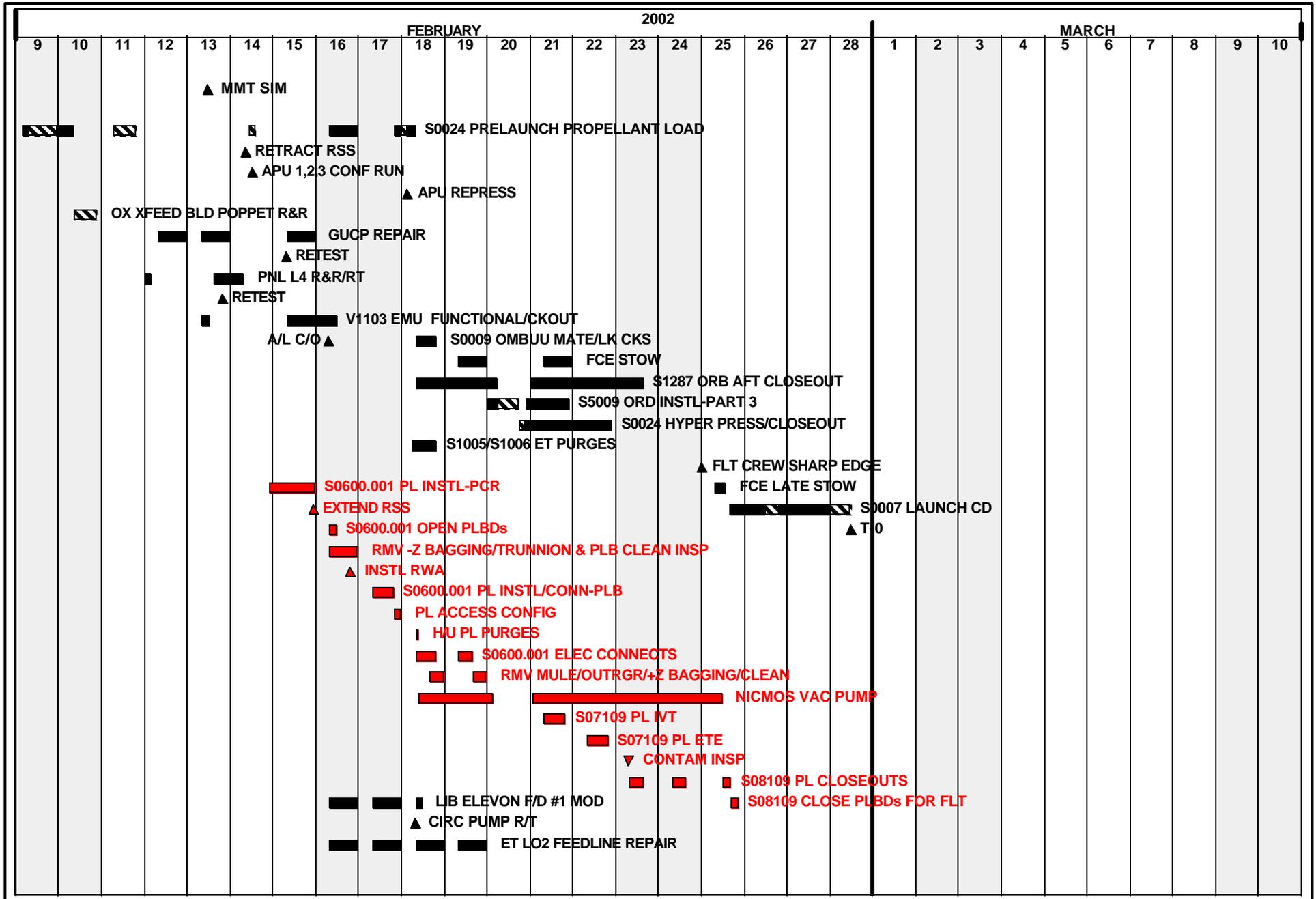
- Planned
 - APU 1/2/3 Confidence Run
 - Late Payload Delivery
 - Payload Bay Cleaning

- Unplanned
 - Panel L-4 Repair
 - APU #3 Lube Oil Pressure Transducer Replacement
 - 7" GH2 GUCP QD Replacement
 - Crawler Transporter Steering Anomaly
 - ET LO2 Feedline TPS Eval/Repair
 - MD326 OMS Ox Fill Air-half QD R&R
 - MD568 OMS X-Feed Bleed Air-Half QD R&R
 - LIB Elevon F/D #1 Blade Seal Eval/Repair
 - MMU #1 R&R
 - Hyd Pump Bolt Eval

STS-109 / OV-102 Operations Summary

OPR: USA - J. Vevera, INT FM(1-2567)
NASA - E. Mango, PH-A2 (1-9221)

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| SHUTTLE ENGINEERING OVERVIEW | Presenter: Greg Crews |
| | Organization/Date: Ground Ops/02-14-02 |

The following Topics have been reviewed:

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| ● Requirements Status – OMRS | No Issues |
| ● TOPS Status | No Issues |
| ● LCC/GLS Status | No Issues (in Backup) |
| ● Software, SCAN, and Configuration Status | No Issues |
| ● Vehicle/GSE Modification Status | No Issues |
| ● In-Flight Anomaly Status | No Issues |
| ● Lost Item Problem Reports | No Issues (in Backup) |
| ● Time/Life Cycle | No Issues |
| ● Critical Process Changes | No Issues |
| ● Unexplained Anomalies | To Be Presented |
| ● Safety, Quality, and Mission Assurance | No Issues |
| ● Engineering Topic | To Be Presented |
| ● Nonstandard Work Summary | No Issues |

**UNEXPLAINED ANOMALIES
MID AC1 PHASE-A ANOMALY****Presenter:****Greg Crews****Organization/Date:****Ground Ops/02-14-02**

- Observation
 - While closing Payload Bay Doors (PLBD's) at the Pad, Midbody AC1 Phase-A was not received at several latch/door drive motors (Phases B & C were nominal)
 - The anomaly was present on motors common to Mid Motor Control Assembly 1 (MCA 1)

- Concerns
 - A repeat of the anomaly during the mission
 - Affected motor-set (MCA-1) operation would still occur on 2 of 3 AC phases
 - Redundant motor-set is unaffected

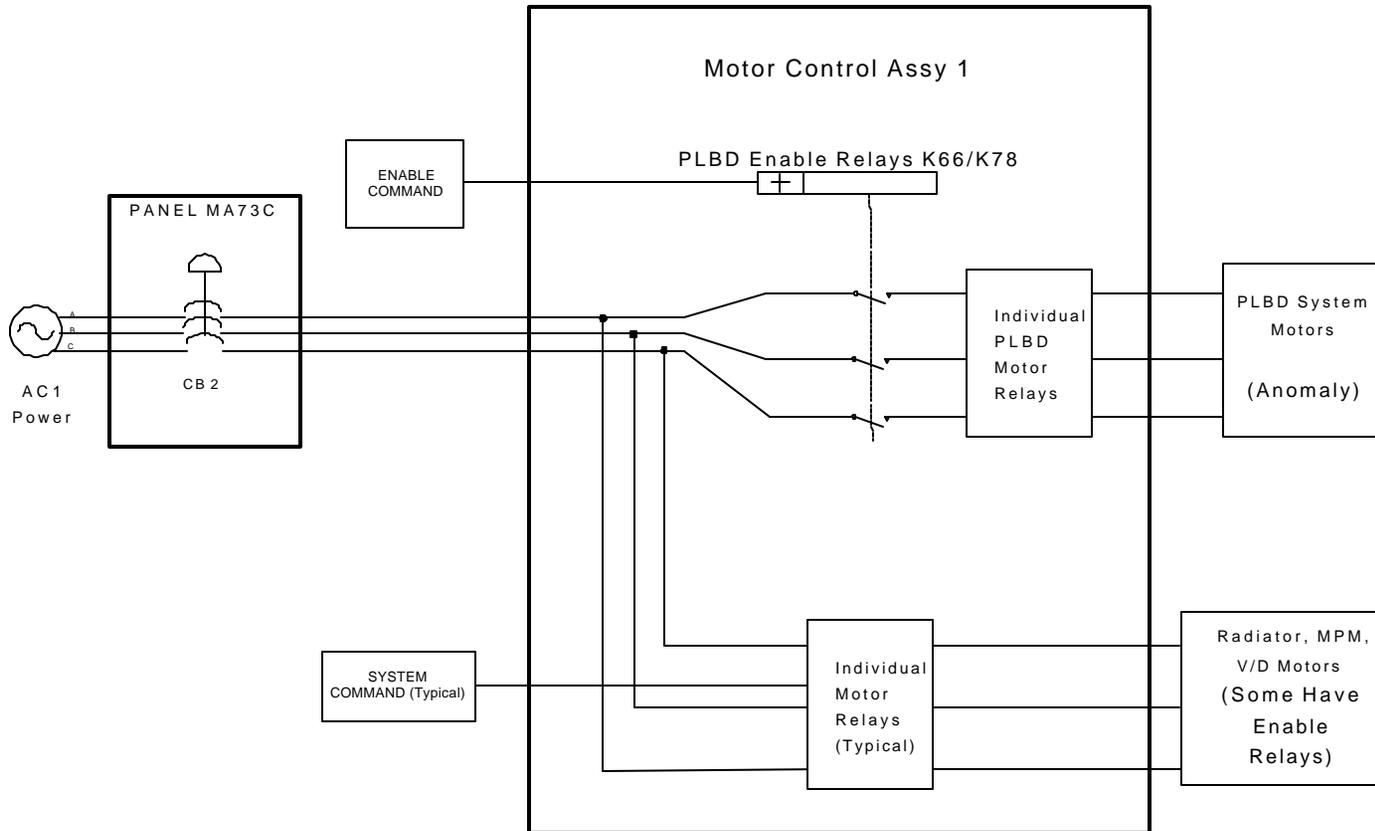
**UNEXPLAINED ANOMALIES
MID AC1 PHASE-A ANOMALY
(CONT'D)****Presenter:****Greg Crews****Organization/Date:****Ground Ops/02-14-02**

- Discussion
 - There have been prior occurrences of this nature
 - Caused by dirty circuit breaker contact, subsequently cleared
 - Mid MCA 1 receives AC 1 power from Panel MA73C, Circuit Breaker 2 (CB 2)
 - This isolates the anomaly to MCA 1, Panel MA73C, or the path between components
 - A repeat of this anomaly during the mission would only be visible on the ground through motor current draw data
 - Motors would operate on 2 phases

UNEXPLAINED ANOMALIES MID AC1 PHASE-A ANOMALY (CONT'D)

Presenter:
Greg Crews

Organization/Date:
Ground Ops/02-14-02



Mid MCA 1 Schematic

**UNEXPLAINED ANOMALIES
MID AC1 PHASE-A ANOMALY
(CONT'D)****Presenter:****Greg Crews****Organization/Date:****Ground Ops/02-14-02**

- Actions Taken
 - Four different motors, fed by the PLBD Enable Relays K-66/78, were operated immediately following the anomaly – Phase A not present on any of the motors
 - Enable relays cycled once
 - Isolates problem to be upstream of individual motor relays (Enable relays, copper path or CB 2)
 - CB 2 on Panel MA73C was cycled 5 times, and anomaly repeated
 - Cycled an additional 5 times – anomaly still present
 - CB 2 left open at end of shift

**UNEXPLAINED ANOMALIES
MID AC1 PHASE-A ANOMALY
(CONT'D)****Presenter:****Greg Crews****Organization/Date:****Ground Ops/02-14-02**

- Actions Taken (Cont'd)
 - CB 2 closed and R/H Vent Door 3 was cycled the following shift with no anomaly
 - Verifies nominal operation of CB 2
 - PLBD Enable Relays K-66/78 not in this path
 - PLDB Latches operated on subsequent shift with no anomaly
 - Anomaly has not repeated since

**UNEXPLAINED ANOMALIES
MID AC1 PHASE-A ANOMALY
(CONT'D)****Presenter:****Greg Crews****Organization/Date:****Ground Ops/02-14-02**

- Possible Causes
 - Intermittent failure of copper path between Panel MA73C and Mid MCA 1
 - Highly unlikely – no activity outside of breaker switch operation
 - No current draw signature indicating intermittent open/short
 - Dirty Phase A contact on one of the Mid MCA 1 Enable Relays (K-66/78), subsequently cleared with relay cycle
 - Unlikely – not a common failure
 - Dirty contact on Phase A of CB2 on Panel MA73C

- Most Probable Cause
 - Dirty contact on Phase A of CB2 on Panel MA73C
 - This condition has been seen multiple times on same configuration breakers

**UNEXPLAINED ANOMALIES
MID AC1 PHASE-A ANOMALY
(CONT'D)****Presenter:****Greg Crews****Organization/Date:****Ground Ops/02-14-02**

- Flight Rationale
 - The loss of Phase A (2 of 3 good phases) will not prevent the operation of the PLBD motors
 - Three phase AC motors have a sub-level of redundancy by design
 - A redundant set of motors for all PLBD operations are unaffected by this anomaly
 - Different circuit breakers, MCA and copper path
 - PLBD latches will be cycled 10 times to exercise enable relays
 - PLBD and V/D motor current draw will be monitored through remainder of door operations at the Pad
 - All MCA AC circuit breakers paths will be verified after final launch count positioning with V/D operations
 - CB 2 will be left closed for remainder of ground processing, and is only opened during the mission for contingency starboard radiator deploy ops

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| UNEXPLAINED ANOMALIES MID AC1 PHASE-A ANOMALY (CONT'D) | Presenter: Greg Crews |
| | Organization/Date: Ground Ops/02-14-02 |

- Risk Assessment
 - No risk to Flight and Crew's safety or Mission success

ENGINEERING TOPICS**Presenter:****Greg Crews****Organization/Date:****Ground Ops/02-14-02**

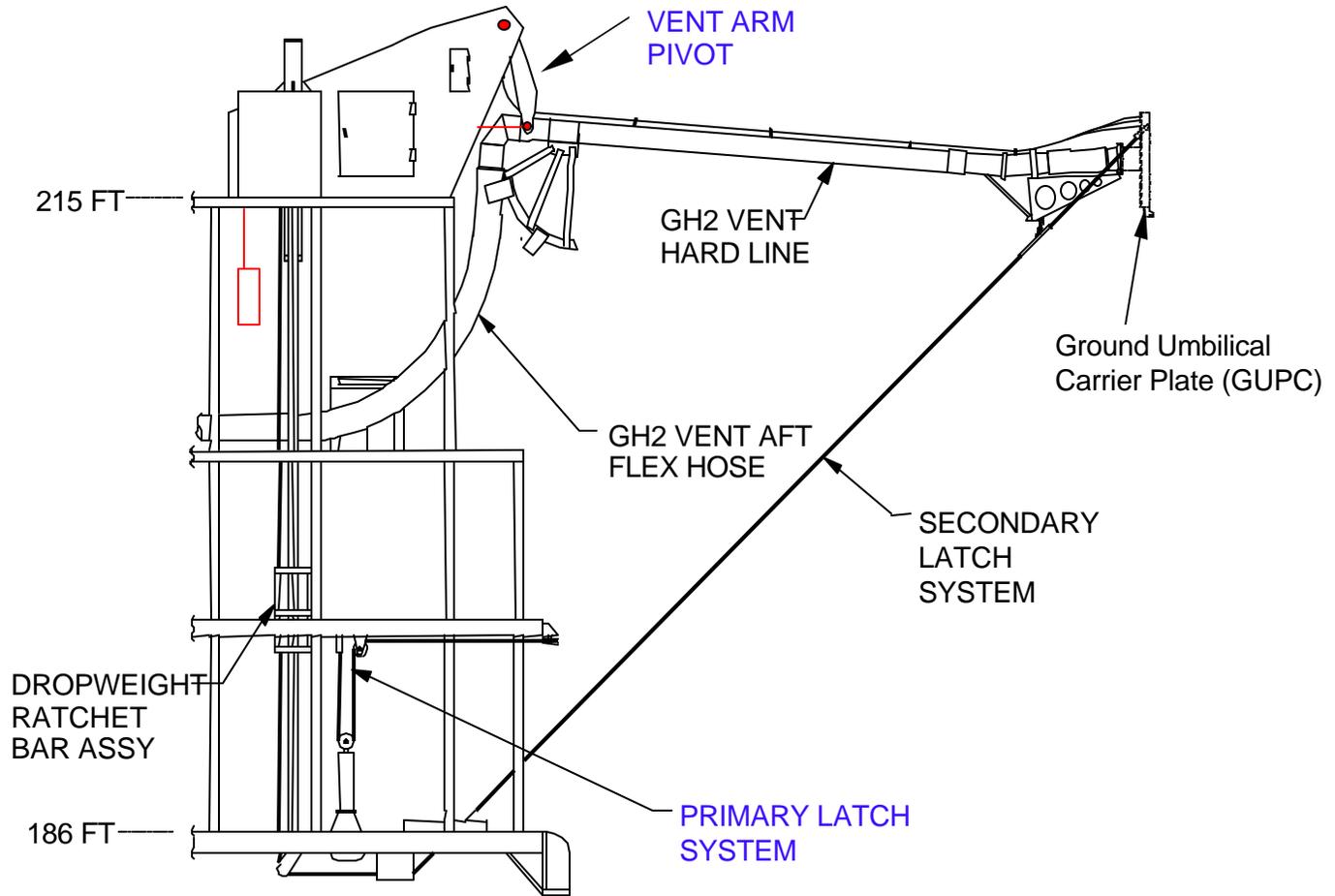
- External Tank Hydrogen Umbilical Retract Anomaly (IFA STS-108K-01)
- Hazardous Gas Detection System (HGDS) 2000 (Information)

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| ENGINEERING TOPIC ET HYDROGEN UMBILICAL RETRACT ANOMALY (STS-108) | Presenter: Greg Crews |
| | Organization/Date: Ground Ops/02-14-02 |

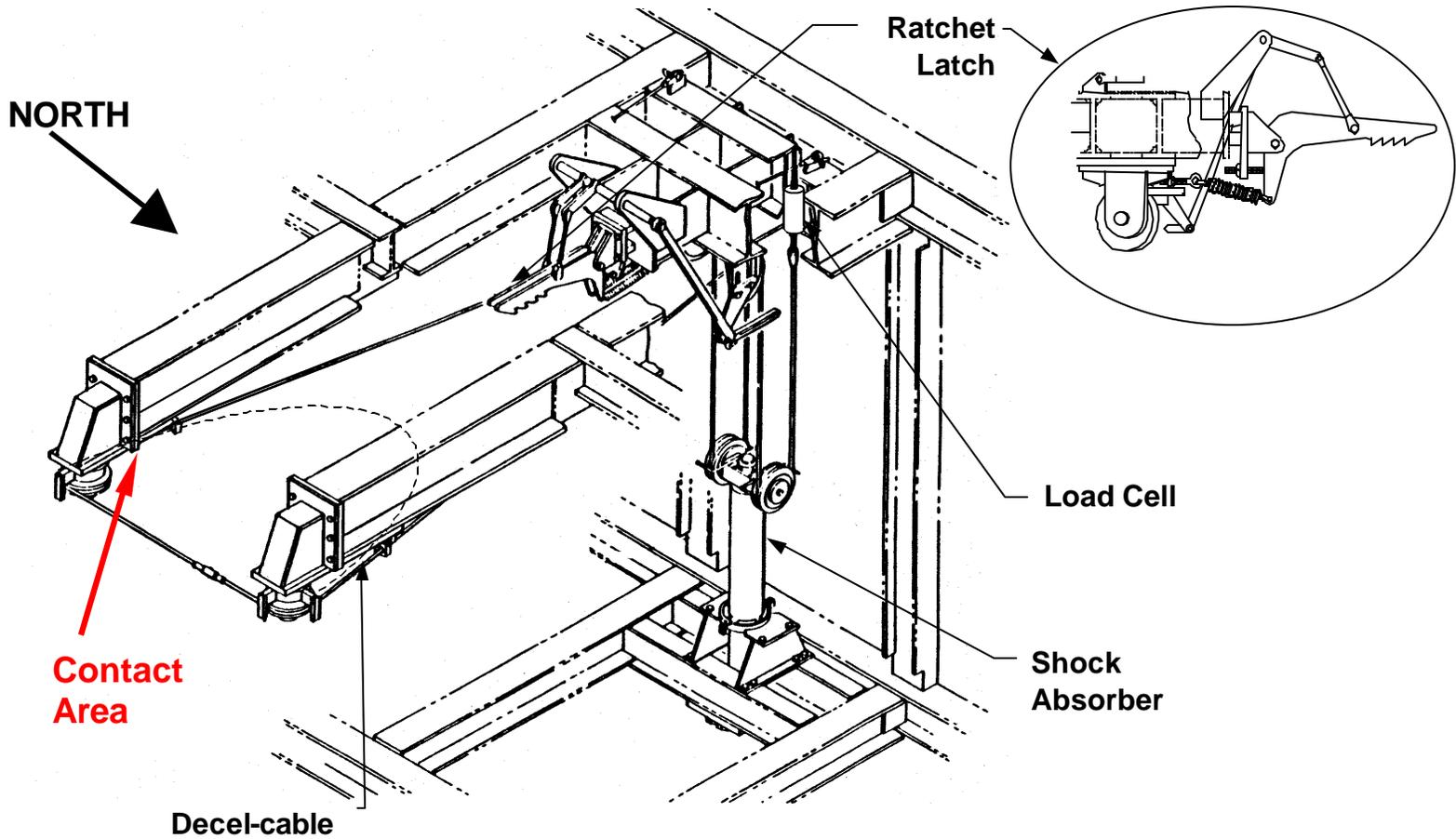
- Observation
 - During STS-108 (Pad B), the Hydrogen Vent Arm contacted the Fixed Support Service Structure (FSS) just prior to engaging the primary latching system, causing hardware damage to the vent arm and FSS
 - The vent arm was captured by the secondary capture feature as designed
- Concern
 - Potential debris impact with vehicle
 - Damage to Ground Support Equipment

**ENGINEERING TOPIC
ET HYDROGEN UMBILICAL
RETRACT ANOMALY (STS-108) (CONT'D)**

**Presenter:
Greg Crews
Organization/Date:
Ground Ops/02-14-02**



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| ENGINEERING TOPIC ET HYDROGEN UMBILICAL RETRACT ANOMALY (STS-108) (CONT'D) | Presenter: Greg Crews |
| | Organization/Date: Ground Ops/02-14-02 |
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PRIMARY LATCH SYSTEM

**ENGINEERING TOPIC
ET HYDROGEN UMBILICAL
RETRACT ANOMALY (STS-108) (CONT'D)**

Presenter:

Greg Crews

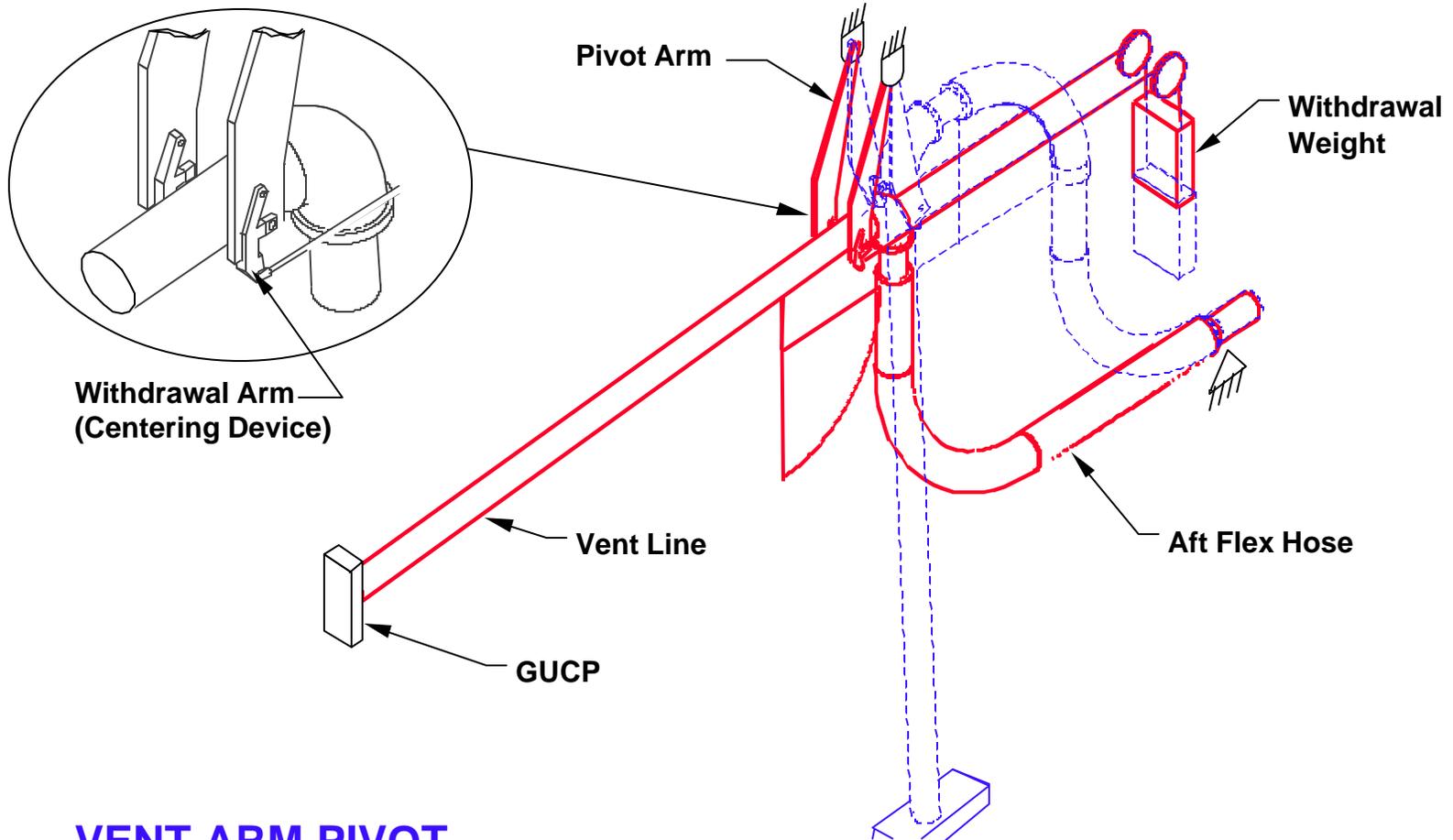
Organization/Date:

Ground Ops/02-14-02



View of STS-109 Vent Arm Prior to Lift and Mate

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| ENGINEERING TOPIC ET HYDROGEN UMBILICAL RETRACT ANOMALY (STS-108) (CONT'D) | Presenter: Greg Crews |
| | Organization/Date: Ground Ops/02-14-02 |
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VENT ARM PIVOT

**ENGINEERING TOPIC
ET HYDROGEN UMBILICAL
RETRACT ANOMALY (STS-108) (CONT'D)**

Presenter:

Greg Crews

Organization/Date:

Ground Ops/02-14-02



Pivot Arm Shocks

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| ENGINEERING TOPIC ET HYDROGEN UMBILICAL RETRACT ANOMALY (STS-108) (CONT'D) | Presenter: Greg Crews |
| | Organization/Date: Ground Ops/02-14-02 |

- Discussion
 - No prior occurrences of Vent Arm contact with structure
 - Pivot Arm Withdrawal Weight reduced from 2000 to 1500 lbs prior to 'Return-to-Flight' (STS-26R)
 - To increase GUCP Pyro bolt margin
 - Vent arm has been contacting the deceleration cable south of center since withdrawal weight change
 - A USA/NASA team composed of Operations, SR &QA and Engineering was formed to perform investigation
 - Fault Tree generated and addressed
 - 86 items addressed
 - 2 open items remaining

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| ENGINEERING TOPIC ET HYDROGEN UMBILICAL RETRACT ANOMALY (STS-108) (CONT'D) | Presenter: Greg Crews |
| | Organization/Date: Ground Ops/02-14-02 |

- Actions Taken / Fault Tree Analysis
 - Previous launch film and data analyzed
 - STS-108 stack position was nominal
 - STS-108 GUCP release time and angle in-family
 - Tank movement nominal
 - Ice build-up on GUCP was less than normal
 - Wind data showed little to no correlation with vent line drop trajectory
 - Vent arm has been contacting deceleration cable south of center since Withdrawal Weight Modification (STS-26R)
 - More pronounced at Pad B

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| ENGINEERING TOPIC ET HYDROGEN UMBILICAL RETRACT ANOMALY (STS-108) (CONT'D) | Presenter: Greg Crews |
| | Organization/Date: Ground Ops/02-14-02 |

- Actions Taken / Fault Tree Analysis (Cont'd)
 - Survey data taken of both Pads
 - Pad A and B vent arm centerline positioning is within specification
 - Pad A is 1.36 inches north of centerline
 - Pad B is 0.66 inches south of centerline

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| ENGINEERING TOPIC ET HYDROGEN UMBILICAL RETRACT ANOMALY (STS-108) (CONT'D) | Presenter: Greg Crews |
| | Organization/Date: Ground Ops/02-14-02 |

- Actions Taken / Fault Tree Analysis (Cont'd)
 - Fault Tree open items
 - Pivot Arm Shocks (1.11.1)
 - Pad B pivot arm shocks sent to lab for testing
 - High load required to compress north shock
 - Could decrease centering capability and cause arm to drop south
 - Pad A shocks to be removed/tested – ECD 2/22
 - No constraint to Pad A – pending nominal shock installation

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| ENGINEERING TOPIC ET HYDROGEN UMBILICAL RETRACT ANOMALY (STS-108) (CONT'D) | Presenter: Greg Crews |
| | Organization/Date: Ground Ops/02-14-02 |

- Actions Taken / Fault Tree Analysis (Cont'd)
 - Fault Tree open items
 - Aft Flex Hose Stiffness (1.6)
 - Hastelloy hose at Pad B (4 flights) slightly stiffer than stainless hose at Pad A, based on material properties
 - Actual hose stiffness desired – no spares to test
 - Team determined withdrawal weight reduction contributes to pivot arm forward motion
 - Not a constraint to Pad A (STS-109)
 - Original stainless hose installed at Pad A
 - Pad B Analysis remains I/W
 - Not a constraint to STS-109

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| ENGINEERING TOPIC ET HYDROGEN UMBILICAL RETRACT ANOMALY (STS-108) (CONT'D) | Presenter: Greg Crews |
| | Organization/Date: Ground Ops/02-14-02 |

- Most Probable Causes
 - Pad B structure off-set is causing the vent line to contact the deceleration cable more to the south as compared to Pad A
 - Decreased centering capabilities of the vent arm during retraction
 - Aft flex hose is stiff enough to raise the (reduced) withdrawal weight and rebound the pivot arm forward
 - High north pivot arm shock compression load

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| ENGINEERING TOPIC ET HYDROGEN UMBILICAL RETRACT ANOMALY (STS-108) (CONT'D) | Presenter: Greg Crews |
| | Organization/Date: Ground Ops/02-14-02 |

- Actions Taken For STS-109 (Pad A)
 - Gained additional clearance on south side of deceleration cable structure (STS-108 contact area)
 - Removed 1 1/4 inch from bracket on structure
 - Pad A south deceleration structure is 3/8 inch further south than Pad B
 - Removed vent line lifting bracket – debris source during STS-108
 - Pivot arm shocks to be tested for nominal operation
 - Deceleration cable painted to help determine contact point
 - Additional cameras (4) installed to better evaluate system dynamics
 - Bright tape added to structure and vent line in previous contact area to aid in film analysis

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| ENGINEERING TOPIC ET HYDROGEN UMBILICAL RETRACT ANOMALY (STS-108) (CONT'D) | Presenter: Greg Crews |
| | Organization/Date: Ground Ops/02-14-02 |

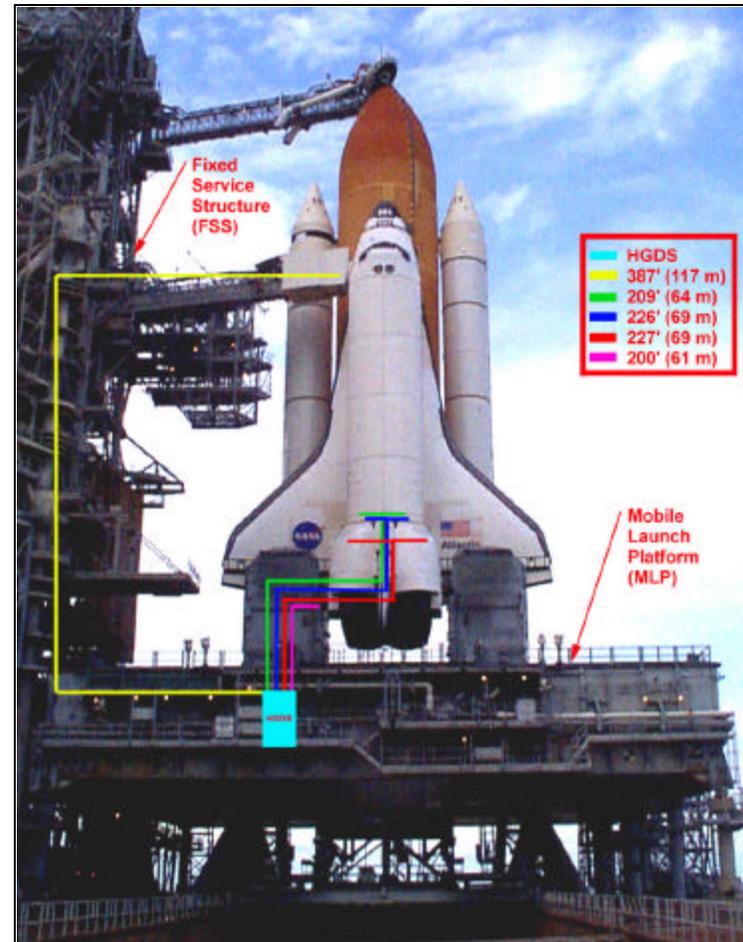
- Flight Rationale
 - Fault Tree analysis is complete – no constraint for Pad A
 - Due to Pad A vent arm north off-set, Pad A vent arm has more clearance to the deceleration structure
 - Additional clearance obtained at previous contact area
 - Material removed from south side structure bracket
 - Lifting bracket (sheared off during STS-108) removed to mitigate debris risk
 - Pivot arm shocks will be tested (open work – brief at L-2)
- Risk Assessment
 - No risk to Flight and Crew's safety or Mission success

**ENGINEERING TOPIC
HAZARDOUS GAS 2000**

**Presenter:
Greg Crews**

**Organization/Date:
Ground Ops/02-14-02**

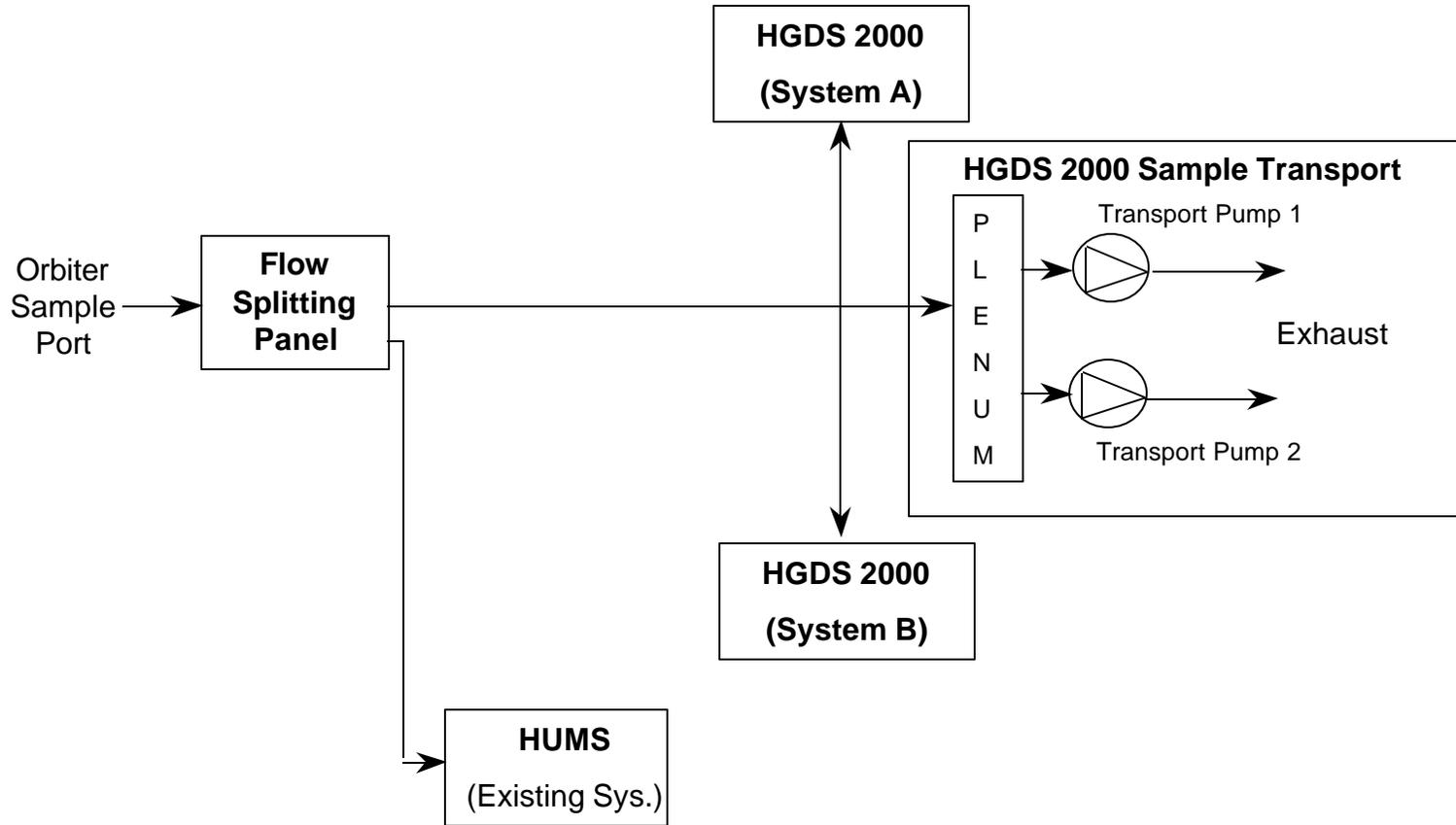
- Purpose
 - The HGDS provides real-time gas analysis for the Orbiter, ET, and Hydrogen Umbilicals
 - Five sample lines monitor for H₂, O₂, He and Ar
 - ET inter tank area
 - LH₂ Tail Service Mast (TSM)
 - Payload Bay
 - Midbody
 - Aft



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| ENGINEERING TOPIC HAZARDOUS GAS 2000 (CONT'D) | Presenter: Greg Crews |
| | Organization/Date: Ground Ops/02-14-02 |

- Previous HGDS Configuration
 - Prime HGDS – in use since STS-1
 - Backup HGDS – in use since Return-to-Flight
 - Hydrogen Umbilical Measurement System (HUMS) – in use since 1990
 - Prime and Backup HGDS hardware had become aged and extremely labor intensive to maintain and operate

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| <p>ENGINEERING TOPIC HAZARDOUS GAS 2000 (CONT'D)</p> | <p>Presenter: Greg Crews</p> |
| | <p>Organization/Date: Ground Ops/02-14-02</p> |



Current Configuration HGDS 2000

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| ENGINEERING TOPIC HAZARDOUS GAS 2000 (CONT'D) | Presenter: Greg Crews |
| | Organization/Date: Ground Ops/02-14-02 |

- HGDS 2000 Technology Improvement
 - Turbo Pump replaces Ion Pump
 - Exhausts sampled gas away from Mass Spec
 - Eliminates “Burping” phenomenon (STS-93)
 - More robust system
 - Remotely adjustable Mass Spectrometer

- HGDS 2000 Reliability Improvements
 - Reduces single failure Points
 - Redundant Sample Transport pumps
 - Redundant air data supply paths – systems A/B

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| ENGINEERING TOPIC HAZARDOUS GAS 2000 (CONT'D) | Presenter: Greg Crews |
| | Organization/Date: Ground Ops/02-14-02 |

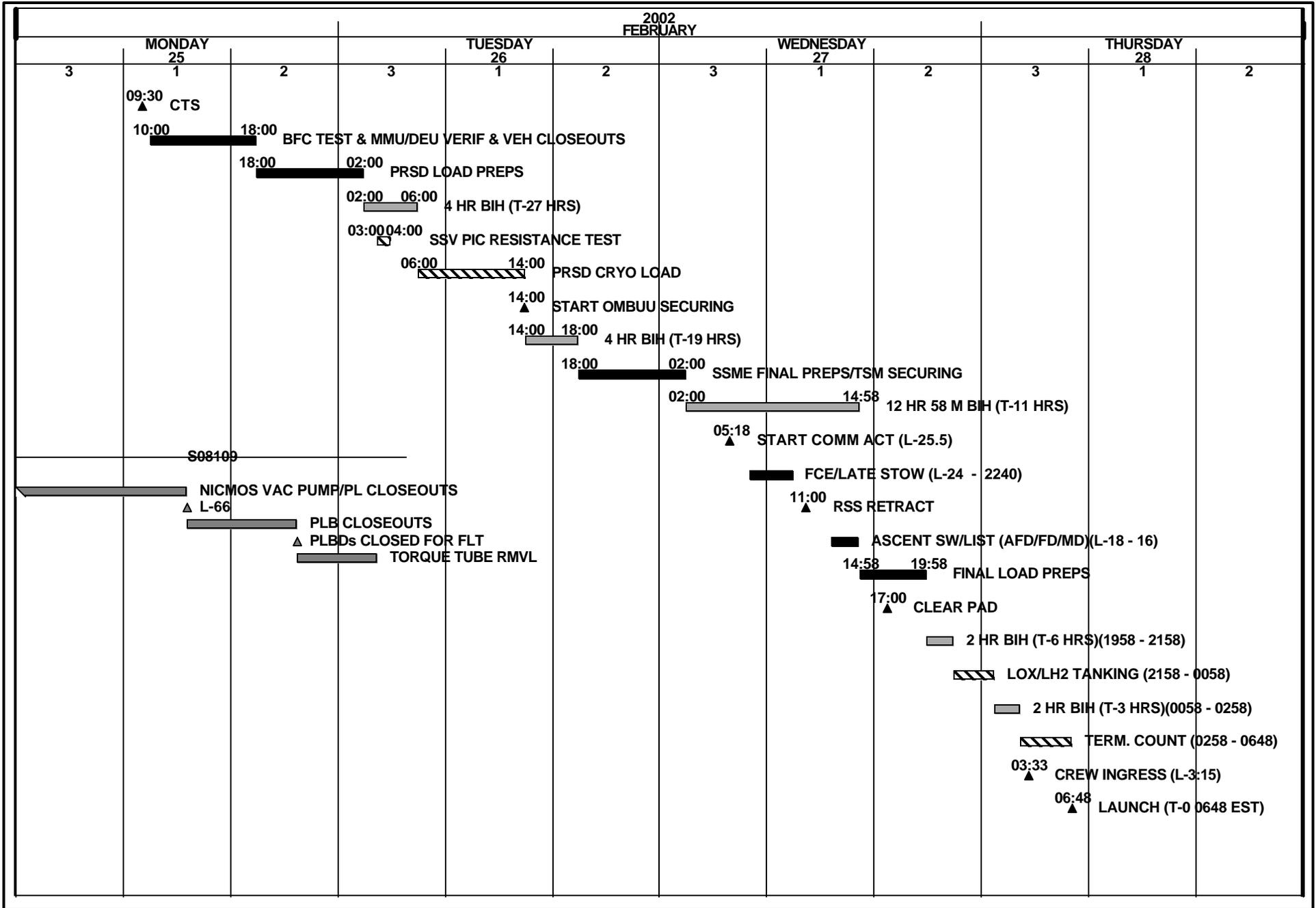
- System Integration
 - Design Certification completed per NSTS-07700 requirements
 - LCC changes involve nomenclature only
 - System has been successfully operated as a prototype for 5 previous flows
 - Users trained on new system
- STS-109 Readiness
 - System certification and validation has been completed
 - Ready to support STS-109

STS-109 / OV-102

Launch Countdown Summary

OPR: S. Altemus (1-9303)

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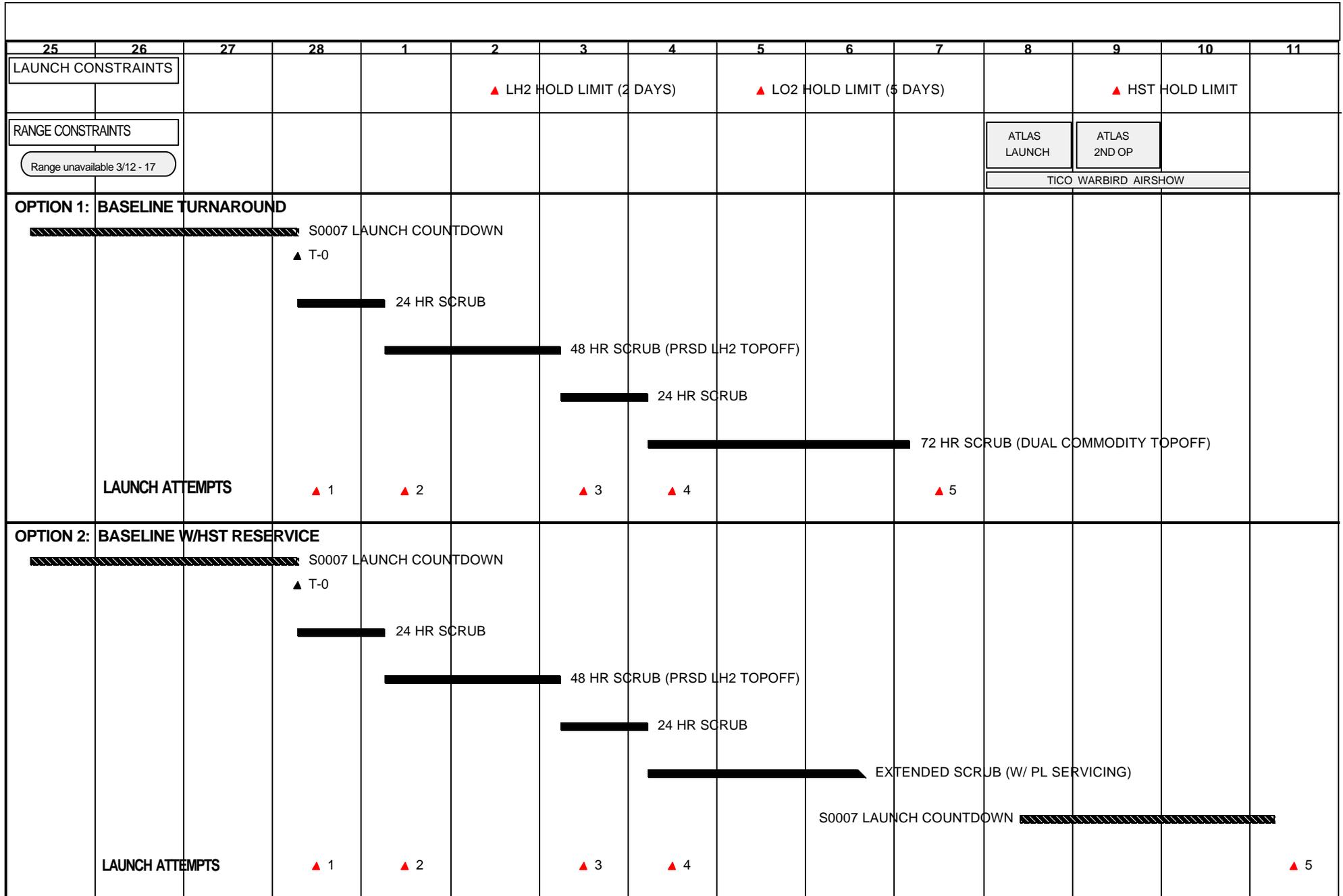
NOTE:
Actual scrub turnaround timelines will be determined
realtime based on specific conditions encountered.

STS-109

LAUNCH COUNTDOWN TURNAROUND OPTIONS

OPR: S. Altemus 1-9302

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LANDING OPERATIONS STATUS

Presenter:

Steve Altemus

Organization/Date:

Launch & Landing/02-14-02

- Launch Support
 - **RTLS:** KSC
 - **TAL:**
 - Ben Guerir (Alt) Deploy at L-7 days, Feb 21, 2002
 - **AOA:**
 - EDW (Prime) Deploy at L-2 days, Feb 26, 2002
 - WSSH (Alt)
- Mission Support
 - KSC (Prime EOM) Deploy at L-2 days, Feb 26, 2002
 - DFRC/EDW
 - WSSH
- Site Status





Kennedy Space Center Shuttle Processing Team



STS-109 Readiness Statement

This is to certify that appropriate CoFR items from NSTS-08117 Appendices H and Q, Flight Preparation Process Plan, have been reviewed and dispositioned. Subject to completion of planned work and resolution of any identified constraints, KSC Shuttle Processing and Supporting Organizations are ready to support Launch Operations.

S/J. Presnell for

Charlie W. Murphy
APM, Integrated Logistics,
USA.

S/Andrew A. Allen

Andrew A. Allen
APM, Ground Operations,
USA.

S/David A. King

David A. King
Director of Shuttle Processing,
NASA

